Journal of Human Centered Technology

https://www.humentech.utm.my E-ISSN: 2821-3467

Research on Intelligent Educational Technology in Business English Education in Building Multi-model Learning Environments and Personalized Learning Paths

Xiaoying Lu[1]*, Norazrena Abu Samah[2]

[1]School of Education, Faculty of Social Sciences and Humanities, Universiti Teknologi Malaysia, 81310 UTM Johor Bahru, Johor, Malaysia

*Corresponding Author: luxiaoying@graduate.utm.my

Cite: https://doi.org/10.11113/humentech.v3n2.84 Research Article

Abstract:
This study investigates the efficacy of intelligent educational technology business English education. It tries to solve the problem of traditional teaching strategies which often fail to meet the diverse needs of students by providing engaging, practical course materials. With an explanatory sequential mixed methods research design, it utilizes thematic analysis for qualitative data from instructors and students, followed by a quantitative survey of 215 business English students. The findings from statistical study indicate that there is a strong positive association between the usage of intelligent educational technology and the improvement of students' business language competency, communication effectiveness, and their overall satisfaction. Moreover, the correlation between students' idea of personalized learning and their motivation, engagement, and performance were significantly positive. In a word, the application of intelligent educational technology can support the development of multi-modal and personalized business English teaching, as well as technology-driven language learning practice, curriculum development, and intelligent educational technology design.

Keywords: Business English; Multi-model learning environments; Personalized learning paths; Intelligent education

1. INTRODUCTION

The ability to communicate in English is a prerequisite for individuals working in the global business environment. The development of students' language and practical skills to adapt to a variety of work circumstances is greatly aided by business English education (1). At present, the outdated business English instructional strategies frequently fail in meeting students' diverse needs, and offering temporizing and interesting course material to help students develop transferable communication skills in real-world contexts (2, 3). There are also challenges facing traditional business English education model in meeting students' individualized learning goals, offering relevant and interesting course material, and fostering effective communication in real-world business settings (2, 3). It is possible that context-rich learning experiences and traditional classroom teaching approaches may not be sufficiently effective in satisfying these varied needs (2). Instructors frequently feel ill-equipped to meet the diverse needs of their students. These difficulties are mainly due to students' learning levels, knowledge backgrounds, learning preferences, as well as the lack of authentic business materials and simulation practice (4, 5). In addition, the necessity for authentic business materials and simulated practices, as well as the diversity of learner ability levels, cultural backgrounds, and learning styles, are the key causes of these difficulties (4, 6). Therefore, effective business English communication skills are crucial for individuals in the context of globalization(1). The development of intelligent education technology provides numerous chances for dealing with these difficulties and improving the learning efficiency of business English. The intelligent technologies such as adaptive learning systems, natural language processing (NLP), and virtual reality (VR) have demonstrated their great potentials in tailoring each student's unique needs in learning like personalized, immersive, and multi-modal experiences (7-9). Educators can also build multi-modal learning environments using a variety of input and output modes, such as text, audio, video, and interactive features, to engage students in learning and cater them for their diverse preferences(10, 11). Moreover, intelligent educational technologies can build personalized learning trajectories adapted to students' unique skills, preferences and goals (12, 13), which all means that there are strong correlations among personalized learning paths and student motivation, cognitive load, and efficacy in language instruction (14, 15).

The artificial intelligence-driven system may streamline the distribution of instructional information and automatically construct personalized learning paths. These prospects align with theoretical frameworks emphasizing perceived utility and sustained support for effective adoption of new technologies. The advance of technological have changed the nature of education. Innovative instructional strategies, more learning opportunities and modern assessment techniques have benefited from technological innovation (16), and language instruction is no exception (7, 17). The emergence of artificial intelligence, virtual reality and adaptive learning systems have expanded the scope of language teaching even more than

Received 01 July 2024; Accepted 09 August 2024
Available online 09 August 2024

before Kuddus (18). For instance, virtual reality technology can simulate real-world language use environments so that students are not bound by time and place, and intelligent tutoring systems can provide personalized tutoring and feedback based on student characteristics (19). The instruction of business English may benefit greatly from these technical advancements, which also have the potential to improve the educational process.

Multi-model learning environments, integrating various modes of communication, like visual, auditory, motor ways, etc., produce both attracting and successful learning experiences (10) to help students to enhance comprehension and retention by complementing multiple modes of communication (11). Similarly, multi-modal technologies are used in language education to explore the usefulness of interactive films, gamified content, visual aids and other multimedia resources (20). Studies have found that multi-model settings are suitable for a wide range of different learning styles, which have proved to be a positive effect on increasing student motivation and engagement, facilitating communication and growing cultural awareness (21, 22). Simultaneously, a number of academics have investigated the connectivism theoretical framework, revealing its coincidence with the interconnectedness of multi-modal learning environments in terms of technology and knowledge sharing, as well as the role of interconnected networked learning in shaping the learning experience (23, 24). Research also tries to study a multi-modal dynamic learning network by connecting various resources such as videos, interactive information and online platforms to help students further their understanding of business English (24, 25).

Furthermore, through individualized content distribution and adaptive algorithms that provide personalized learning pathways catering to every student's particular requirement, preferences, and learning style, the personalized learning pathways support student autonomy in the classroom (13). Some scholars have demonstrated that personalized learning paths in language education environments can boost student motivation, lessen cognitive load and ultimately improve academic performance (12, 15). Currently, scholars have studied the implementation and effectiveness of the use of adaptive platforms and intelligent tutoring systems on personalized learning in language education (26). Some scholars (27), have demonstrated the potential benefits of personalized learning pathways in addressing different learner backgrounds, learning styles and skill levels, leading to a more efficient and engaging learning experience. Other researchers have also argued that personalized learning is compatible with constructivism theory which emphasize active learning, social interaction and knowledge construction (28). Adaptive systems can be used to tailor the delivery of information, while personalized learning pathways enable students to actively shape their learning process according to their preferences, existing knowledge and personal needs (25). A few current studies have explored multi-model learning environments and personalized learning paths in language education respectively, but not much has been covered in the field of business English education, and there are still many research gaps and potential research directions that need to be explored in depth.

Accordingly, the previous study highlighted the importance of business English instruction in the current globalized business environment, pointing out the difficulties of traditional teaching methods in meeting the needs of diverse student groups, providing timely instruction, and developing useful communication skills. It is possible that the integration of intelligent technology into language education may promote the formation of advanced instructional strategies, inspire learning activities and sophisticated assessment and so on. In addition, multi-model learning environments adapting to different learning styles form multiple modes of communication, deepening students' understanding. Besides this, personalized learning paths fitting for learner's individual needs and preferences encourage learner autonomy and participation. Although the previous study has paid attention to the effect of multi-model learning environments and personalized learning path, there are still some issues and areas to be further explored, especially in the combination of these two aspects in Business English education. To provide a comprehensive understanding of this topic, this research may employ an explanatory sequential mixed methods design that combines quantitative and qualitative research techniques.

Semi-structured interviews with educators, curriculum designers, and students were conducted as part of the qualitative phase. Document analysis of pertinent instructional materials was also conducted. The benefits, drawbacks, and best practices associated with multi-model and personalized learning approaches were identified through thematic analysis. The integration of intelligent technology-powered individualized learning pathways has been shown to enhance students' motivation, engagement, and performance. These results align with the ideas of self-determination theory (29), as well as with empirical evidence supporting the motivating advantages of adaptive, individualized learning (30). By addressing the identified research gaps and utilizing theoretical frameworks like constructivism and connectivism, this study aims to investigate the integration of multi-model learning environments, intelligent educational technologies, and personalized learning paths into business English education. It is to provide insights into the long term impacts of technology-based language learning practices, multi-model assessment technologies, and personalized learning paths on business English proficiency. It is also hoped that the findings of this study can be used as a guide to help one create novel and engaging approaches to teaching business English that are responsive to the demands of the digital age and the diverse needs of students in international corporate environments. Based on the problems stated, this study proposed three research questions, as follows:

Question 1: In what ways may intelligent educational technology facilitate a multi-model learning environment that enhances students' business English communication skills?
Question 2: What is the impact of intelligent education technology-enhanced individualized learning paths on students' performance, motivation, and involvement in business English instruction?
Question 3: What challenges need to be addressed to successfully integrate personalized learning pathways and multi-modal learning environments into business English courses, and how can intelligent technologies be used to settle these barriers?

2. METHODOLOGY

This study employs a mixed-method approach based on the overarching concept proposed by Creswell & Clark (31) for both quantitative and qualitative data collection and analysis. It involves of combining quantitative and qualitative data analysis to comprehensively investigate complex events. Tashakkori & Teddlie (32) asserted that the qualitative method is designed to provide in-depth insights and contextual understanding, while the quantitative method is responsible for generating numerical data and conducting statistical analysis, forming a comprehensive review of the research topic and enhances the validity and reliability of the findings by integrating data from multiple sources (33). This is the reason that a mixed-method approach was chosen for this study.

A total of 215 students and 5 instructors were the subjects of this study. The sample instructors were selected basing on their educational background, teaching level and subjects. This method is coincided with Patton's (34) purposive sampling strategy for qualitative research. Also, to ensure that the student sample was representative of different levels of academic achievement, a stratified random sampling technique was used to select freshman, sophomore, and junior students separately.

To ascertain students' attitudes and perceived impacts towards multi-modal learning environments and personalized learning paths, as well as their actual performance in language ability improvement, the quantitative data were collected via a standardized questionnaire. In this study, student opinions, attitudes, and experiences on pertinent research issues were gathered by standardized survey questionnaires. The questionnaire was designed, and data collection were collected via a standardized questionnaire in accordance with the best practice guidelines set out by Dillman and his partners (35), with both closed-ended and Likert scale items, while semi-structured interviews with five instructors and student focus groups were employed to gather qualitative data. An interview protocol, as proposed by Rubin & Rubin (36), was utilized during the interviews with instructors and students, facilitating discussion while allowing for flexible inquiry.

This study aims to provide a comprehensive picture of the use of intelligent educational technology. Quantitative data were collected mainly through an online questionnaire. The questionnaire was created by the researcher and went through a pre-testing and testing process to ensure its validity and reliability. The 215 students who participated in the survey were Business English students from different grades. Qualitative data was collected through focusing on group discussions with students and semi-structured interviews with five teachers. To ensure that participants were in a comfortable and familiar setting, data collection was conducted on campus in accordance with the guidelines set out by Creswell & Poth (37). Students are required to finish the questionnaire in about 30 minutes, and 40 minutes to finish the group focusing interview, while one-on-one instructor interview also takes about forty minutes. Prior to data collection, questionnaires and interviews were pre-tested and reviewed by experts to reduce any potential bias throughout the data collection process (36, 38) while measures were also taken to ensure participant confidentiality and anonymity, consistent with ethical guidelines outlined by Sieber & Tolich (39). A set of operationalized questions is employed to assess fundamental concepts such as individualized learning pathways and multi-model learning environments. The frequency and degree of pleasure with which students are exposed to and utilize text, audio, visual, and interactive aspects, for instance, are used to quantify multi-model learning environments. Student assessments on the flexibility of the course material, their own development, and the instructional strategies are included in the measurement of individualized learning pathways. All questions were subjected to expert assessment to guarantee content authenticity and were based on previously published material and theoretical frameworks.

The quantitative analysis will use statistical software such as SPSS to conduct descriptive and inferential statistical analysis. The using techniques including frequency distributions, central tendency measures, correlation analysis, and appropriate hypothesis testing based on the research questions and data, which is consistent with Fidell's research (40). Qualitative interview data were fully transcribed using and thematic analysis techniques were used (41). As suggested by Saldaña (42), classifying data is done in order to identify emerging themes, patterns, and insights .

3. RESULTS

Based on three main research questions, this study provides results that propose the use of intelligent educational technologies to create learning environments for personalized learning paths and multi-model business English instruction and learning. The study used SPSS statistical software for processing and quantitative data analysis. Among them, descriptive statistical analysis provides an overview of the overall situation of the participants and how they perceive the effects of intelligent educational technology applications, while inferential statistical analysis, such as correlation analysis and paired samples t-test, is used to evaluate improving students' business English communication skills through personalized learning paths multi-model learning environment.

The first research question is "In what ways may intelligent educational technology facilitate a multi-model learning environment that enhances students' business English communication skills? To answer this question, quantitative analysis is used to assess the improvement in students' business English communication skills following their exposure to a multi-model learning environment supported by intelligent technology. Specifically, the four modules of the standardized Business English proficiency test are: writing, speaking, listening, and reading. The scores for the four modules are standardized on a 100-point grading system, with 15 points for writing, 20 points for speaking, 30 points for listening and 35 points for reading. Students' performance in each module has improved significantly since the introduction of intelligent learning technology. We have included the following graph in the results section to illustrate more clearly how intelligent educational technology improves business English communication skills:

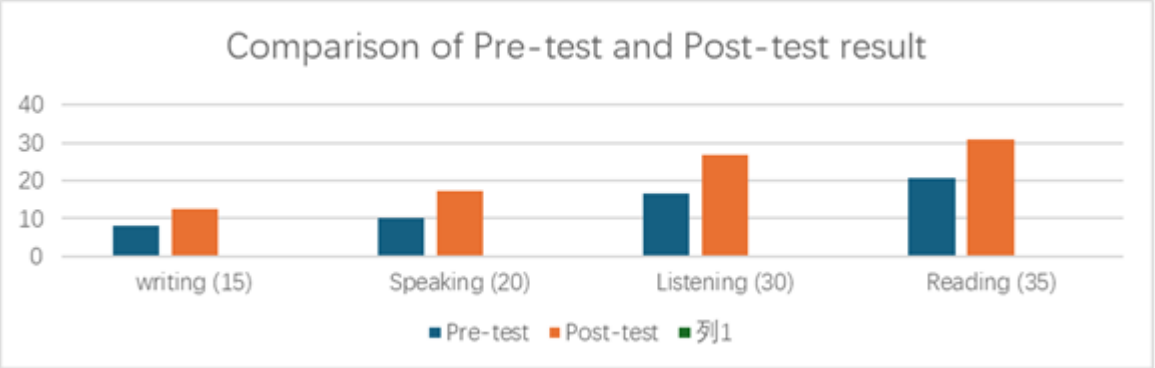

Figure 1: Comparison of pre- and post-test results for business English proficiency.

It is clear from the graph that the post-test scores for all modules were significantly higher than the pre-test scores. Special statistical information can be found in Table 1:

Table1: Pre- and post-test business English assessment scores.

Skill Area	Pre-Test M (SD)	Post-Test M (SD)	t (215)	p	Cohen's d
Writing 15	8.275 (2.5)	12.405 (1.8)	24.89	<0.001	1.71
Speaking 20	10.24 (3.2)	17.38 (2.3)	32.76	<0.001	2.19
Listening 30	16.74 (4.5)	26.73 (3.2)	34.18	<0.001	2.02
Reading 35	20.79 (5.0)	31.01 (3.5)	30.95	<0.001	1.76

Note. Degrees of Freedom for all tests = 215. Cohen's d values of more than 0.8 represent large effect sizes, respectively.

The analysis of Table 1 shows the result of writing as follows: The mean pre-test score was 8.275 (SD = 2.5) and the mean post-test score was 12.405 (SD = 1.8). Writing skills improved significantly, as indicated by the statistically significant improvement (t (214) = 24.89, p<0.001, Cohen's d = 1.71) in the results of the paired samples t-test. Spoken English module: The pre-test mean was 10.24 points (SD = 3.2), while the post-test mean was 17.38 points (SD = 2.3), both showing a significant improvement (t (214) = 32.76, p<0.001, Cohen's d = 2.19). The listening module yielded a mean score of 16.74 points (SD=4.5) at pre-test and 26.73 points (SD = 3.2) at post-test. There was also a statistically significant improvement (t (214) = 34.18, p<0.001, Cohen's d = 2.02). Finally, it goes to the reading module: the mean pre-test and post-test scores were 20.79 (SD = 5.0) and 31.01 (SD = 3.5) respectively. There was a significant improvement (t (214) = 30.95, p<0.001, Cohen's d = 1.76).

The results indicate that the use of intelligent technology in a multi-model learning environment significantly improves students' business English communication skills. The speaking and listening modules had the greatest impact on improvement, according to the calculation of effect sizes (Cohen's d). These results are consistent with theoretical predictions that multi-model learning environments provide more opportunities for practice and richer linguistic input. These findings are consistent with Krashen's opinion. An important component of language acquisition is to provide understandable language input, and the learning of business English is an important aspect of language acquisition. The research results on intelligent multi-modal research and personalized paths for business English learning are one of the important aspects for the application of intelligent educational technology in language teaching, providing empirical support and further verifies its effectiveness in business English teaching. Semi-structured student interviews provided qualitative data (n = 20) that suggested possible mechanisms behind these changes. Three key themes emerged from the analysis of interview transcripts: (a) Interactive multimedia content enhances learner engagement and motivation; (b) Contextualized learning in real business scenarios, and (c) AI-powered personalized feedback and powerful language analysis tools. These findings are consistent with other research that has demonstrated the importance of contextualized and authentic learning experiences (Jaccomard & Kuuse, 2016) and the benefits of multi-model teaching in increasing learning motivation (Blikstein, 2013).

The second research question is "What is the impact of intelligent education technology-enhanced individualized learning paths on students' performance, motivation, and involvement in business English instruction?" The impact of personalized learning pathways on students' intrinsic motivation, engagement and course success is the main topic of this research question. The purpose of the correlation analysis results from the simulation study is to assess the relationship between learner motivation, engagement and achievement and perceptions of individualized learning pathways. We found significant relationships between students' perceptions of personalized learning paths and their self-reported motivation, engagement and overall performance in business English courses after conducting a correlation analysis of survey data from 215 business English students. There was a positive relationship, see the details in Table 2.

From Table 2, the correlation coefficient between perceptions of personalized learning pathways and self-reported motivation was 0.67 (p<0.001), indicating a moderate to strong positive correlation. It reveals that personalized learning pathways can increase students' intrinsic motivation is supported by this finding. The correlation coefficient between personalized learning path perceptions and overall performance in Business English courses is 0.71 (p<0.001), and the correlation between personalized learning path perceptions and engagement is 0.78 (p<0.001), indicating a significant positive correlation between personalized learning paths and learner engagement. The correlation coefficient between

performance and intrinsic motivation is 0.62 (p<0.001), and the correlation between performance and engagement is 0.81 (p<0.001), indicating a significant positive correlation between performance and intrinsic motivation and learner engagement.

Table2. Influence of technology to motivation, engagement, and performance in business English instruction.

Related Variables	Correlation Coefficient (r)	*p*	Contribution to Research
Personalized learning path and student's intrinsic motivation	0.67	<0.001	It is strong correlations. It is confirmed that personalized learning path can significantly enhance students' intrinsic motivation.
Personalized Learning Paths and Learner Engagement	0.71	<0.001	It is very strong correlations. It shows that there is a significant positive correlation between personalized learning paths and learner engagement, which supports the effectiveness of personalized teaching methods.
Personalized learning path and Course Learning Performance	0.78	<0.001	It is very strong correlations. It shows that personalized learning path has a positive effect on students' overall learning performance in business English courses.
Course learning performance and Intrinsic Motivation	0.62	<0.001	It is strong correlations. It shows that Intrinsic Motivation has a positive effect on students' performance in business English courses.
Course learning performance and Learning Engagement	0.81	<0.001	It is very strong correlations. It shows that learning engagement has a positive effect on students' learning performance in business English courses.

This finding suggests that students' overall performance in business English courses is positively influenced by personalized learning paths. These statistical findings demonstrate how intelligent educational technology can successfully increase students' motivation and participation in the learning process by providing personalized learning paths, thereby improving the effectiveness of language acquisition. Self-determination theory (29) emphasizes the value of individualized learning environments that promote autonomy in fostering intrinsic motivation and engagement, and these findings are consistent with this approach.

The third research question is "What obstacles must be addressed to successfully integrate individualized learning paths and multi-modal learning environments into business English courses, and how might intelligent educational technology be used to address these obstacles?" Here, thematic analysis (41) of semi-structured interviews with instructors (n = 5) and students (n = 20) revealed several key challenges in integrating multi-model and personalized learning approaches, as summarized in Table 3. These challenges were consistent with previous literature on educational technology integration, which has cited factors such as technical difficulties, time constraints, resistance to change, and limited training as common barriers (43).

Table 3. Summary of the challenges in integrating multi-modal and personalized learning.

Challenges	Number	Illustrative Quote
Technology Compatibility	5 instructors 18 students	"Getting all the different software and hardware to work together was a constant struggle." "Computer is a little outdate, sometimes the apps don't work well". "Sometimes we have to take hours to download and learn to use the new technology". "The internet connection is not so good"
Time Limitation	4 instructors 19 students	"Preparing personalized content for each student was incredibly time-consuming, sometimes we are in hurry."
Not willing to change the teaching or learning way	3 instructors 12 students	"Some colleagues were hesitant to adopt these new teaching methods." "I am afraid I don't know how to use, and it will influence my operation so that I cannot learn it well"
Inadequate training and support to instructors and students	3 instructors 17 students	"I felt like I was thrown into the deep end without enough guidance." "I don't know how to deal with the equipment, I need more training". "We need more training and practice to know how to use them well".

This study used a systematic analysis approach to describe and identify the main difficulties in fusing multi-model and personalized learning approaches through semi-structured interviews with five instructors and 20 students from the population. After the interview data were transcribed verbatim, the textual content was categorized into significant themes and sub-themes using an open coding procedure. Through continuous comparison and refinement of these categories, the following major themes were identified Problems with technology and compatibility: Instructors often noted that challenges in implementing technology were caused by incompatibilities between different hardware and applications. This finding is consistent with a study by Ertmer *et al*. (43), which highlights the difficulties with technology compatibility during technology integration as follows: 1 - Technology Compatibility: instructors report that it is a big challenge to make the

technology compatibility. For students, the outdate facilities is a big problem. 2 - Time limitation: instructors report that it takes a great deal of time to prepare knowledge that is specific to every student, setting back the development of personalized education. For students, they cannot finish their preparation and online test on time sometimes. 3 - Resistance to change: Some instructors feel that the implementation of new teaching methods is hindered by internal problems, which affects the dissemination of these methods. But students are afraid that the new change will make the work assignment and test more difficult. 4 - Limited training and support: Most teachers reveal that they didn't receive enough training the usage of intelligent educational technologies, making it difficult for them to integrate these tools into their regular lesson plans.

4. DISCUSSION

Research displays that multi-model learning environments, including the delivery of multiple interactions and materials such as text, audio, video, simulations, and interactive exercises, can improve business English communication skills, while multi-model learning technologies can improve business English communication skills by adapting to different learning styles and preferences by increasing their learning engagement, understanding and retention of Business English topics and communication strategies. In addition, the integration of authentic multimedia resources and interactive role-playing games can provide students with real scenarios and opportunities to hone their business English skills in a low-pressure environment, preparing them to solve actual professional communication difficulties. Finally, in the multi-modal learning environment created by intelligent technology, students' business English writing, speaking, listening and reading abilities have been greatly improved. The large effect sizes (Cohen's d > 0.8) discovered in every skill area in the quantitative analysis provided proof of this major influence. This result supports the hypothesis that students' English language competency rises in multi-model settings with an abundance of intelligent technological tools, supporting earlier research (44). Notably, the effect sizes in this study add to the corpus of empirical studies demonstrating the efficacy of multi-model, technologically enhanced language instruction and validate the validity of these conclusions (45).

Students' motivation, engagement and overall performance were found to be positively correlated with their perceptions of personalized learning pathways. Self-determination theory (29) highlights the importance of autonomy, relatedness and competence in fostering intrinsic motivation and engagement, and our findings are consistent with these principles. By creating a learning path that is specific to each student's needs, preferences and characteristics, intelligent technology helps students to develop a sense of autonomy and belonging. It increases students' intrinsic motivation and learning engagement. In addition. Furthermore, language analysis tools driven by intelligence education technology can meet students' personalized needs and provide targeted support within their zone of proximal development, thus contributing to the observed achievement gains (46). It is also consistent with the principles of cognitive load theory (47), who suggests that good instructional design should control cognitive load and provide appropriate scaffolding to maximize learning and skill development. Qualitative analysis also demonstrates how personalized learning paths support students' feeling of relevance and ownership, increasing their engagement and involvement in the learning process. It is also consistent with research by Huang *et al.* (30). Business English teaching requires the use of advanced educational technology, since not only personalized learning pathways can improve student motivation, engagement, and performance, but multi-model learning environments can help students communicate more effectively with language. These findings have important implications for the instructional way of business English as well as students' communication skills, allowing for a deeper exploration of the use of intelligent educational technologies in language learning environments to optimize educational impact and provide further practical inspiration.

This study mainly uses thematic analysis of instructors' interview and students' interview to identify the main challenges in the effective integration of multi-modal learning environments and personalized learning paths into business English courses and analyzes the feasible solutions utilizing intelligent educational technologies. Among them, time constraints, compatibility issues, change resistance, lack of training and assistance, technical barriers, etc. are some of the challenges that have been noted, causing difficulties for educators to implement and utilize state-of-the-art teaching tools in the teaching process. However, intelligent teaching technology may be able to solve these problems. Learning management systems with artificial intelligence capabilities can speed up the delivery of multi-model information and automatically create personalized learning paths for each user. It reduces administrative workload while ensuring a high-quality, unified learning experience. This is consistent with Davis's (48) technology acceptance paradigm that emphasizes perceived usefulness and usability as key factors in encouraging successful technology adoption. In addition, according to the problem-oriented Employing paradigms, real-time data analysis, and feedback systems can help instructors promptly identify and resolve technical issues or areas that require additional training. This facilitates a more flexible and motivating implementation process (49).

Through the analysis of the research results, it is recommended to organize regular professional development meetings and training seminars on the use of intelligent educational tools to improve teachers' awareness and acceptance of creative teaching strategies, as well as to promote the implementation of personalized teaching methods through learning powerful intelligent support systems. This is also consistent with the research of Haryanto & Ali (50) and Lesia *et al*. (51). Additionally, AI-driven learning management systems can optimize content distribution and automatically create personalized learning paths. And its real-time data analysis and feedback mechanism can also help identify and resolve technical issues or training needs. Although intelligent technology poses obstacles to teaching development, it can improve students' performance, motivation, and participation, while helping them develop business English communication skills using multi-modal learning environments and personalized learning paths. Finally, both qualitative and quantitative statistics indicate the possibility of using intelligent technologies to overcome existing barriers in teaching, but the smooth integration of these methods remains difficult. In a word, these findings will greatly influence the design and implementation of technology-enhanced language learning environments, especially in business English teaching.

The creative development of teaching methods is promoted using intelligent educational technology, which also innovates the conventional teaching paradigm. To achieve truly individualized teaching, instructors can modify the content and difficulty of their lessons according to the understanding and learning progress of their students, for example by adaptive learning systems. In addition, the use of virtual reality technology offers students the opportunity to replicate an office environment, making the learning experience more practical and contextual. The implementation of social strategies in this study is consistent with constructivist and connectionist theories by emphasizing learners' active participation and knowledge construction. As the research displays that business English education integrating with intelligent education technology can help to cultivate students' creative thinking and problem-solving abilities by providing more experiential and practical learning opportunities. Intelligent education technology offers a more efficient approach to foster students' overall skill development in addition to creating new avenues for business English learning. Furthermore, the deeply exploring of the actual implementation of intelligent educational technology in business English instruction provides theoretical guidance, useful reference, creative development of intelligent educational technologies and teaching methods for students, broadening a new perspective on how to support the overall growth of business English professions. Finally, this research offers valuable motivation for more studies and practical applications concerning the use of intelligent educational technology in the teaching of business English. By providing a solid theoretical foundation and referencing prior research, this study adds to the scholarly discourse by deepening our understanding of the benefits and drawbacks of incorporating intelligent technology into language learning settings.

5. CONCLUSION

This study systematically studies the application of intelligent educational technology in business English instruction with the emphasis on evaluating the role of intelligent educational technology in the development of personalized learning paths and multi-modal learning environments. The research lays a theoretical foundation for language education and provide a useful guidance for classroom practice. In response to the original research question, the data analysis results clearly show that students' business English communication skills (covering multiple areas such as writing, speaking, listening and reading) are significantly improved due to the multi-modal learning environment supported by intelligent technology. This finding confirms the importance of multi-model learning environments in language acquisition and is consistent with previous research. Additionally, this research shows a positive effect on students' motivation, engagement, and academic achievement by multi- model learning environment and personalized learning paths. This finding suggests that students' motivation, like sense of learning autonomy, learning engagement can be enhanced under multi-model learning environment and personalized learning path. Intelligent technology can also provide personalized feedback, helping students to realize their full potential in their zone of proximal development.

This study provides some valuable insights for business English learning. However, some limitations exist. 215 students are a relatively small sample size, and the research period is relatively short, which may mean that it is not big enough and long enough to observe long-term effect and durability of behavioral changes. In addition, this study focused on the individual learning paths of business English students in a multimodal environment, which may affect the generalizability of the findings. Future research can address these limitations by increasing the sample size, using longitudinal research methods, and exploring the interaction between teaching methods and educational technology to increase the size and diversity of the sample and extend the study period to capture long-term effects.

To sum up, the study highlights the potential of intelligent educational technologies to improve instructional strategies and learning achievement in business English with ongoing support and perceived benefits, to promote successful technology adoption. Even though there are some barriers to intelligent technology integration, like time constraints, technical difficulties, and training requirements, the challenges can be effectively overcome by streamlining system operations and comprehensive analysis. Additionally, the study reveals potential avenues for further research. These include increasing sample size, using longitudinal research methods, and thoroughly investigating the interaction between teaching methods and educational technology. Future research should also focus on the difficulties and potential applications of cutting-edge technologies such as augmented reality and virtual reality in business English teaching. In a word, these findings provide a strong theoretical and empirical justification for the use of intelligent educational technology in business English education and suggest future directions for scholarly research and educational reform. Intelligent educational technology is expected to play a greater role in the global business English education and to meet the growing learning needs because of the continuous advancement of technology and the development of educational practice.

ACKNOWLEDGMENT

I appreciate my tutor, Associate Professor Dr Norazrena Abu Samah, who guide the writing. We also appreciate with the students who involved in this research. It is one of my process papers of PHD of Education Technology of UTM, and also funded by a projected Reform and Practice Research on Virtual Simulation Experimental Teaching Mode of Business English Class Courses Based on STEAM---An Undergraduate Teaching Reform Project of Guangxi Education Department in 2022 (2022JGB399).

CONFLICT OF INTEREST

The authors declare no conflict of interest.

REFERENCES

(1) Muliyah P, Aminatun D. Teaching English for specific purposes in vocational high school: Teachers' beliefs and practices. J English Teach. 2020; 6(2):122–133. https://doi.org/10.33541/jet.v6i2.1756.

(2) Rajprasit K, Sirisuksakulchai J, Srimontra K, Pitakpornsin N, Letakulkit P, Phaiboontham P, Dumrongruedee S. Using Business English as a Lingua Franca for written and spoken communication: Challenges encountered by Thai human resources professionals in an American multinational company. 3L Lang Linguist Lit. 2022; 28(4). http://doi.org/10.17576/3L-2022-2804-02.

(3) Rustamov I, Mamaziyayev Z. Development of speaking comprehension in teaching foreign language for professional purposes. Asian J Res Soc Sci Human. 2022; 12(2):227–233. https://doi.org/10.5958/2249-7315.2022.00099.5.

(4) Avsheniuk N, Seminikhyna N. Challenges of teaching and learning business English in Ukrainian universities. Arab World English J. 2020; 68–78. https://dx.doi.org/10.24093/awej/elt3.6.

(5) Eli T. Students perspectives on the use of innovative and interactive teaching methods at the University of Nouakchott Al Aasriya, Mauritania: English department as a case study. Int J Technol Innov Manag. 2021; 1(2):90–104. https://doi.org/10.54489/ijtim.v1i2.21.

(6) Ananiadou S, McNaught J, Thompson P, Rehm G, Uszkoreit H. The English language in the digital age. Heidelberg: Springer Berlin; 2012. https://doi.org/10.1007/978-3-642-30684-6.

(7) Bárcena E, Martín-Monje E. 1 Introduction. Language MOOCs: An Emerging Field. In: Elena Martin M, Elena Bárcena M, editors. Language MOOCs. Warsaw, De Gruyter Open Poland: Poland; 2014. p. 1–15. https://doi.org/10.2478/9783110420067.1.

(8) Troussas C, Krouska A, Sgouropoulou C. Collaboration and fuzzy-modeled personalization for mobile game-based learning in higher education. Comput Educ. 2020; 144:103698. https://doi.org/10.1016/j.compedu.2019.103698.

(9) Ullah N, Mugahed Al-Rahmi W, Alzahrani AI, Alfarraj O, Alblehai FM. Blockchain technology adoption in smart learning environments. Sustainability. 2021; 13(4):1801. https://doi.org/10.3390/su13041801.

(10) Stickler U, Hampel R, Emke M. A developmental framework for online language teaching skills. Australian J Appl Linguist. 2020; 3(1):133–151. https://doi.org/10.29140/ajal.v3n1.271.

(11) Watts-Taffe S. Multimodal literacies: Fertile ground for equity, inclusion, and connection. Read Teach. 2022;75(5):603–9.

(12) Mwambe OO. Adaptive e-learning multimedia content personalization approach based on learner's cognitive processes. 2022.

(13) Raj NS, Renumol V. A systematic literature review on adaptive content recommenders in personalized learning environments from 2015 to 2020. J Comput Educ. 2022; 9(1):113–148. https://doi.org/10.1007/s40692-021-00199-4.

(14) Lin C-H, Zhang Y, Zheng B. The roles of learning strategies and motivation in online language learning: A structural equation modeling analysis. Comput Educ. 2017; 113:75–85. https://doi.org/10.1016/j.compedu.2017.05.014.

(15) Yaraş Z. Evaluation of academic procrastination behavior in management of personal learning environments within intelligent tutoring systems. J Educ Technol Online Learn. 2021; 4(4):576–593. https://doi.org/10.31681/jetol.1015928.

(16) Sonkar S, Liu N, Mallick D, Baraniuk R. CLASS: A design framework for building intelligent tutoring systems based on learning science principles. Findings of the Association for Computational Linguistics: EMNLP 2023; 2023. https://doi.org/10.18653/v1/2023.findings-emnlp.130.

(17) Godwin-Jones R. Evolving technologies for language learning. Lang Learn Technol. 2021; 25(3):6–26.

(18) Kuddus K. Artificial intelligence in language learning: Practices and prospects. Adv Analytics Deep Learn Models. 2022:1–17. https://doi.org/10.1002/9781119792437.ch1.

(19) Liang J-C, Hwang G-J, Chen M-RA, Darmawansah D. Roles and research foci of artificial intelligence in language education: an integrated bibliographic analysis and systematic review approach. Interact Learn Environ. 2023; 31(7):4270–4296. https://doi.org/10.1080/10494820.2021.1958348.

(20) Ramezanali N, Uchihara T, Faez F. Efficacy of multimodal glossing on second language vocabulary learning: A meta-analysis. Tesol Quarterly. 2021; 55(1):105–133. https://doi.org/10.1002/tesq.579.

(21) Durham C. Centering equity for multilingual learners in preservice teachers' technological pedagogical content knowledge (TPACK). J Teach Educ. 2024:00224871231223460. https://doi.org/10.1177/00224871231223.

(22) Gilakjani AP, Ismail HN, Ahmadi SM. The effect of multimodal learning models on language teaching and learning. Theory Prac Lang Stud. 2011; 1(10). https://doi.org/10.4304/tpls.1.10.1321-1327.

(23) Downes S. Recent Work in Connectivism. European J Open Distance E-Learning. 2020; 22(2):113–132. https://doi.org/10.2478/eurodl-2019-0014.

(24) Goldie JGS. Connectivism: A knowledge learning theory for the digital age? Med Teach. 2016; 38(10):1064–1069. https://doi.org/10.3109/0142159X.2016.1173661.

(25) Mattar J. Constructivism and connectivism in education technology: Active, situated, authentic, experiential, and anchored learning. RIED Revista Iberoamericana de Educación a Distancia. 2018. https://doi.org/http://dx.doi.org/10.5944/ried.21.2.20055.

(26) Bernacki ML, Greene MJ, Lobczowski NG. A systematic review of research on personalized learning: Personalized by whom, to what, how, and for what purpose (s)? Educ Psychol Rev. 2021; 33(4):1675–1715. https://doi.org/10.1007/s10648-021-09615-8.

(27) Chang T-W, Kurcz J, El-Bishouty MM, Kinshuk, Graf S. Adaptive and personalized learning based on students' cognitive characteristics. In: Kinshuk RH, editor. Ubiquitous Learning Environments and Technologies. Springer Berlin: Heidelberg; 2015. p. 77–97. https://doi.org/10.1007/978-3-662-44659-1_5.

(28) Ertmer PA, Newby TJ. Behaviorism, cognitivism, constructivism: Comparing critical features from an instructional design perspective. Perform Improv Q. 1993; 6(4):50–72. https://doi.org/10.1111/j.1937-8327.1993.tb00605.x.
(29) Ryan RM, Deci EL. Intrinsic and extrinsic motivation from a self-determination theory perspective: Definitions, theory, practices, and future directions. Contemp Educ Psychol. 2020; 61:101860. https://doi.org/10.1016/j.cedpsych.2020.101860.
(30) Huang CS, Yang SJ, Chiang TH, Su AY. Effects of situated mobile learning approach on learning motivation and performance of EFL students. J Educ Technol Soc. 2016; 19(1):263–276.
(31) Creswell JW, Clark VLP. Designing and conducting mixed methods research. 3rd ed. USA: Sage publications; 2017.
(32) Tashakkori A, Teddlie C. Sage handbook of mixed methods in social & behavioral research. USA: Sage publication; 2021.
(33) Bergman MM. Advances in mixed methods research: Theories and applications. 1st ed. USA: Sage publication; 2008.
(34) Patton M. Qualitative research and evaluation methods. 4th ed. USA: Sage publications; 2015.
(35) Dillman DA, Smyth JD, Christian LM. Internet, phone, mail, and mixed-mode surveys: The tailored design method. USA: John Wiley & Sons; 2014.
(36) Rubin HJ, Rubin IS. Qualitative interviewing: The art of hearing data. USA: Sage publication; 2011.
(37) Creswell JW, Poth CN. Qualitative inquiry and research design: Choosing among five approaches: Sage publication; 2016.
(38) Fowler Jr FJ. Survey research methods. USA: Sage publication; 2013.
(39) Sieber JE, Tolich MB. Planning ethically responsible research. USA: Sage Publication; 2012.
(40) Fidell LS. Using multivariate statistics. USA: Allyn and Bacon; 2001.
(41) Braun V, Clarke V. Using thematic analysis in psychology. Qual Res Psychol. 2006; 3(2):77–101.
(42) Saldaña J. The coding manual for qualitative researchers. USA: Sage publication; 2021.
(43) Ertmer PA, Ottenbreit-Leftwich AT, Sadik O, Sendurur E, Sendurur P. Teacher beliefs and technology integration practices: A critical relationship. Comput Educ. 2012; 59(2):423–435. https://doi.org/10.1016/j.compedu.2012.02.001.
(44) Naz S. Role of multimedia-aided EFL classrooms in promoting learners' interaction and participation in tertiary-level Bangladeshi students. J Lang Teach Res. 2023; 14(5):1207-1214. https://doi.org/10.17507/jltr.1405.08.
(45) Golonka EM, Bowles AR, Frank VM, Richardson DL, Freynik S. Technologies for foreign language learning: A review of technology types and their effectiveness. Comput Assisted Lang Learn. 2014; 27(1):70–105. https://doi.org/10.1080/09588221.2012.700315.
(46) Vygotsky LS, Cole M. Mind in society: Development of higher psychological processes. USA: Harvard University Press; 1978. https://doi.org/10.2307/j.ctvjf9vz4.
(47) Sweller J. Cognitive load during problem solving: Effects on learning. Cogn Sci. 1988; 12(2):257–285. https://doi.org/10.1016/0364-0213(88)90023-7.
(48) Davis FD. Perceived usefulness, perceived ease of use, and user acceptance of information technology. MIS quarterly. 1989; 319–340. https://doi.org/10.2307/249008.
(49) Hall GE, Hord SM. Implementing change: Patterns, principles, and potholes. England: Pearson PLC; 2006.
(50) Haryanto E, Ali RM. Students' attitudes towards the use of Artificial Intelligence SIRI in EFL learning at one public university. International Seminar and Annual Meeting BKS-PTN Wilayah Barat; 2019.
(51) Lesia Viktorivna K, Andrii Oleksandrovych V, Iryna Oleksandrivna K, Nadia Oleksandrivna K. Artificial Intelligence in language learning: What are we afraid of. Arab World English J. 2022. https://dx.doi.org/10.24093/awej/call8.18.